THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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THE ELECTRICAL EXHIBITIONS.

WITHIN two days of this date the grand display of electrical inventions now at the Palais de l'Industrie, will, so far as the public are concerned, be terminated. The highest praise is due to all who have taken a share in its promotion and management; to M. Cochery, M. Berger, and M. Breguet, the greatest credit is due, for their enterprise and skill; and of the British Commission also, much might justly be said in praise of the way in which their difficult work has been accomplished, for all the members thereof worked right earnestly and well. Lord Crawford, Professor Hughes, and Mr. Aylmer, have indeed been most indefatigable in their efforts to make the exhibits of their nation in every way worthy of it, and the thanks of the electrical community, we think, will be freely accorded to them for the success so ably obtained. And now, as the electric luminaries of the Paris Exhibition cease to shine, our thoughts begin to be occupied by the on-coming exhibition in the great holiday-making palace on the Sydenham Hills.

After the meeting on the 24th October we wrote that there was every probability of the exhibition being a success, and what we wrote then we fancy will be found correct when everything is ready. December will probably be past before much is placed before the public gaze; but the idea of the directors is, we understand, to let the exhibition gradually expand, and thus leave it open to exhibitors to supplement the exhibits displayed at the commencement. There seems to be but little or no doubt that, from the directors' point of view, so far as the electric light exhibition is concerned, the success must be great. From the electrician's stand-point, however, it may be different. The management make no secret that the shillings are what they cater for, and that they care little for exhibits which are not considered by them attractive to the public. An instance was cited by a very prominent gentleman to show how necessary it was to exclude some of the exhibits which obtrusive (?) inventors were desirous of displaying. We quote as closely as possible from his words; they were as follows:—"Now, we have had an application from some people who want to exhibit gas through which they pass an electric current, and by so doing get more light. It is not electricity, and we cannot therefore admit it; the line must be drawn somewhere!" We could not but feel that this gentleman was not to be congratulated on his discretionary qualifications, for if a given amount of gas and electricity will give more light when combined than when used separately, to demonstrate this fact to the public would for them have an immense attraction, and consequently for the Crystal Palace Exhibition be of great value.

We merely mention this as an indication of the spirit in which the exhibition is being inaugurated. Another sign of this spirit is the omission of what was displayed under Class 16 at the Paris Exhibition, namely, "Bibliographie, Histoire."

Why the directors, having *first* made their programme, should ask the gentlemen who form the honorary council of advice to associate themselves with such an exhibition we cannot see, unless it be merely by way of advertisement. Nor can we perceive the fairness of the appeal to "the City companies and the public generally" to give prizes because "of the public advantages likely to accrue."

The public are not all shareholders!

It cannot be allowed that the Crystal Palace is the best place in or near London for such an exhibition: this, partly because it is essentially a place for pleasure-seekers and not for scientific thinkers, and also because of the £ s. d. way in which it is understood the directors usually regard, and rightly so, their business, and also partly by reason of its distance from the metropolis. Another element likely to prove disadvantageous is that of time; the Exhibition will probably be found to come too soon after that at Paris to attract, as the latter did, electricians from every civilised land. Indeed it seems to us on consideration that the new venture must, to prove the success we wish it, be regarded as a great competitive exhibition of electric lights for the purpose of advertising those lights, and perhaps as a gigantic bazaar and mart at which electrical toys, &c., may find a sale.

We doubt not that thus far the Exhibition will answer the purport of the C. P. directors, but we can only regret that those gentlemen who have nominally been asked to advise the directors had not been invited to do so before the programme had been definitely laid down, so that an electrical display with the widest possible scope and interest might have been held, and not one limited by the main desire to attract so many thousands of the British public at one shilling admission. For it must be borne in mind that by having an exhibition of the kind all too soon and under such conditions, it must militate against the chances of holding one

even more perfect than that of Paris, later on, and, moreover, which might have found, and we hope will find, a temporary home in the more congenial surroundings (from a scientific point of view) of South Kensington. Should this hope be consummated we trust the arrangements will be directed from their commencement by gentlemen interested truly for the advancement of electrical science and in scientific and technical education. Originating with such promoters, the affair will be above the suspicion of other than high class aims, and the promoters cannot well afterwards be placed in the position of effigies intended only to move when the wires are pulled by those who look only for their own special advantage in getting up the show.

As regards the Crystal Palace Exhibition, we think now, as we did when we wrote of the meeting at the Mansion House, that the pecuniary success of the display may be great; but the more we hear of the method of conducting the whole preliminary arrangements, the more are we enlightened as to its non-scientific aim, and as to the nature of the advantages of such an exhibition to the electrical profession.

THE PARIS ELECTRICAL EXHIBITION.

FOREIGN SECTIONS.

ROSSI'S APPARATUS FOR THE CONTINUAL REGISTRATION OF SISMIC EARTH WAVES.

Italy.

THIS apparatus, which is shown by the figure, has four parts—the first of these is called the "*Protosismograph*," and its arrangement is as follows:—A seconds pendulum provided with a very heavy bob is tied by silk cords to four posts corresponding to the N, S, E, and W points of the compass. These cords are of such a length that needles placed at their centre cause them to form an angle of 155°. By this arrangement each horizontal undulation of the pendulum becomes transformed into a vertical movement of the needles of three times the amplitude. Consequently, since the needles are connected above to little metallic spirals of great flexibility, their vertical movements close four electric circuits each time that their points touch the mercury contained in four little cups immediately beneath the points. In this way it is possible to distinguish by means of a registering apparatus each half oscillation of the pendulum, and consequently the direction of the first movement.

The second portion of the apparatus is called the "*Microsismograph*." This has the same mechanical combination as the foregoing instrument, but the silk cords are connected to four pendulums, of different lengths to the centre one. Since these pendulums have different times of oscillation, it follows that at some time or other two pendulums approach one another, and consequently that there is an increase in the number of the needles that make contact. The apparatus is thus able to register pendulous movements of the very smallest degree. Besides, the existence in the apparatus of five pendulums of different lengths gives it the property of responding to sismic waves of different velocities. Experiments made since 1876 have shown that this apparatus is invaluable for sismological purposes, since it can trace out an actual curve of the microsismic and sismic disturbances.

The "*Registering apparatus*" consists of a clockwork movement which causes a paper band to move beneath pencils which are joined to five levers, each movable by the action of a separate electromagnet. Four of these magnets correspond to the four circuits of the protosismograph; the fifth is worked only by the microsismograph. In this last instrument it would be useless to have more than one pencil, for being subject to a variety of extremely slight movements, their direction would be inappreciable.

The "*Sismic microphone*," which forms the fourth part of the apparatus, should be very firmly rooted to the ground, and should have at the same time in its vibrating part a great inertia in order to be insensible to local disturbances. Moreover it should be very steady in its working. With this view it is simply a metallic swing with a screw to regulate its sensibility; the whole is mounted on a stone table like a paper press. The little square metallic support which acts as a spring is for the purpose of supporting an ordinary watch. By this arrangement the only part of the apparatus required for the watch is in a condition of such sensibility as to be capable of showing in the telephone the "tick-tick" of the watch. This "tick-tick" is of great importance in sismic observations.

DE GEYTER'S MULTIPOLAR ELECTRIC MOTOR.

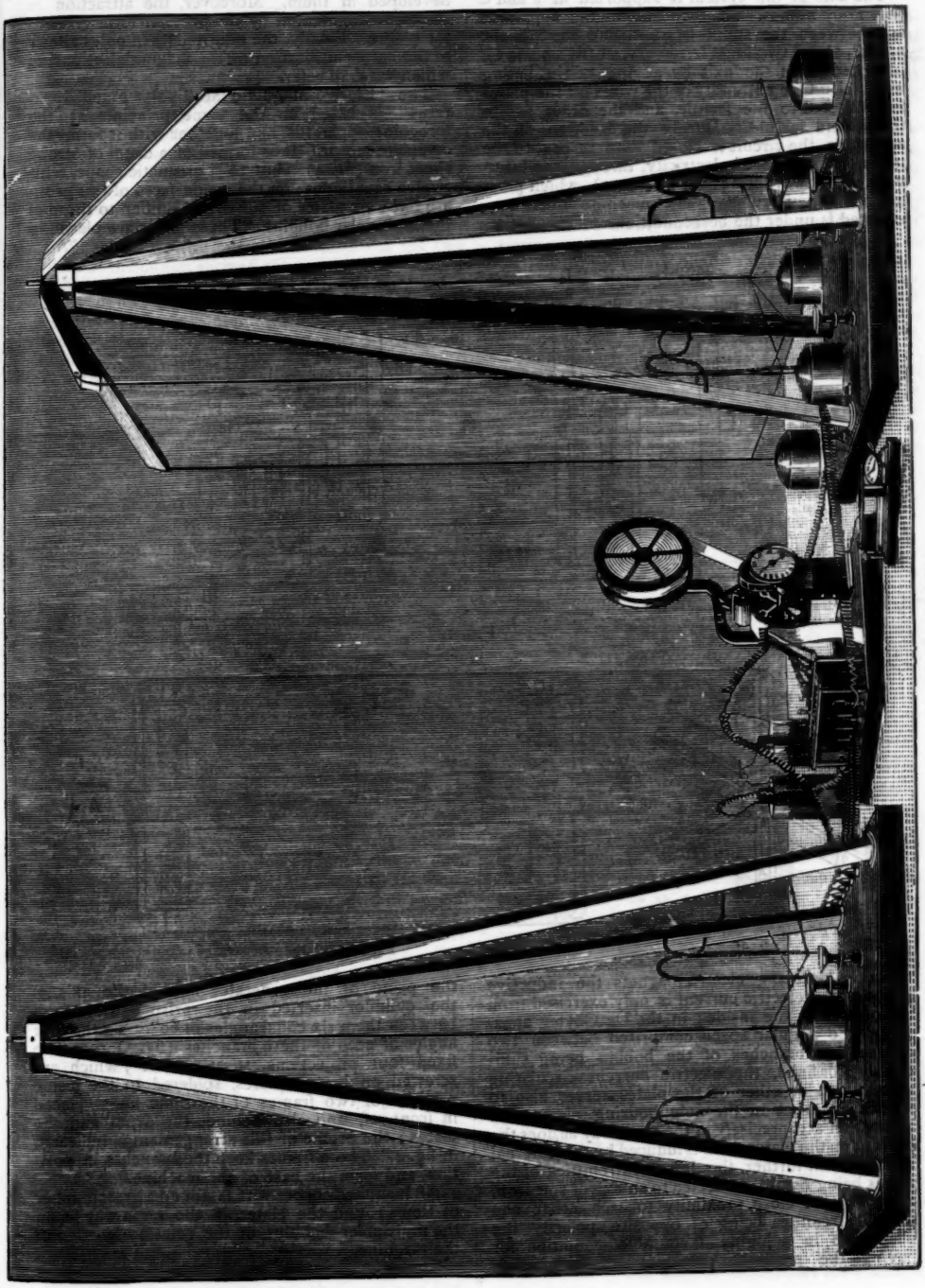
Belgium.

This apparatus is shown in longitudinal elevation by fig. 1 (drawn to the scale of $0.^{m}50$ to 1 metre); it is composed of three parts: 1st, a rotatory apparatus with multipolar electro-magnets (not shown in the figure); 2nd, a fixed multipolar apparatus, A; 3rd, a commutator, T.

The "Electro Magnetic Multipolar Rotatory Apparatus" is formed of an axle, A, A (fig. 2), of soft iron whose end portions are of a smaller diameter than the middle. On this axle are fixed six plates of soft iron, *a*, *b*, *c*, *d*, *e*, *f* (fig. 3), forming between them six equal angles of 60°. These plates are rectangular in form (P, P^{1}, fig. 2), their greatest length being parallel to the centre axle.

At the lower part, to the right and left, the plates carry projections M, M^{1}, which are fixed to corresponding projections on two wheels R, S and R^{1}, S^{1}, these wheels being fixed on to the axle, A, A.

On these plates and along their longer length are wound a number of turns of insulated copper wire of about 1 millimetre diameter. The wire being parallel to the axis of the apparatus, the inductive action of the current which circulates in the wire magnetises the plates, so that their outer edges become poles of one kind and their inner edges poles of the reverse polarity. The same wire is wound successively on all the plates, but so that the alternate plates only have the same polarity.



ROSSI'S APPARATUS.

The axis of the system is supported at C and C (fig. 1) by frames. At each end of the apparatus and between the supports, C, C, and the wheels, R, S, R^1, S^1, are two brass ferrules, V, V^1 (figs. 1 and 2), insulated from the axis by a ring of insulating material. One extremity of the wires on the plates is connected to one ferrule, and the other end to the second ferrule. During the rotation of the apparatus the circuit is closed with respect to the poles of a source of electricity, through the intervention of two springs, L, L^1 (fig. 1), which press against the ferrules. The machine thus constructed is under the best conditions for magnetisation. In ordinary electro-magnets the inductive action of the electric current is only exercised from the outside to the inside; in the De Geyter apparatus, the angular space comprised between two consecutive branches of the bobbin being sufficiently confined, the electric current circulating around one or other of the plates serves also to induce an effect in the neighbouring plates, and this action acts precisely in the same way as does the current on the plate which is induced by this external action. Still further, the lower extremities of the plates being firmly connected to an axis of soft iron, and being in close proximity to each other, and these extremities being of opposite polarity, the plates are in a highly favourable condition for having the maximum amount of magnetism developed in them. Moreover, the attraction is still more augmented by the peculiar form given to the plates. Finally, the multiplicity of poles allows of the better utilisation of the magnetic actions, to which we shall refer.

The "Electro-Magnetic Multipolar Fixed Apparatus" is based on the same principle as the foregoing apparatus, and together with it forms the complete motor. It is formed of a drum of strong sheet iron (fig. 4), bent to a prismatic shape, with twelve equal sides; on the inside faces of this prism are fixed six plates of soft iron, similar to those of the multipolar bobbins. These plates are placed in the plane of the generator and of the axis of the cylinder inserted in the prism; they form between them six equal angles of 60°. To the four angles of each of these branches (fig. 5), there are fixed four projections, M, M', M'', M''', which are screwed on brass squares, soldered to the inside partition of two frames of the same metal, placed in front of, and also behind, the drum and the plates; the profile of this arrangement is indicated in fig. 4. These frames keep the branches in position, and form the base of the machine.

An insulated copper wire is wound a great number of times round the plates, in the same way as on the multipolar bobbins of the rotatory portion of the machine.

The general management of the apparatus is as

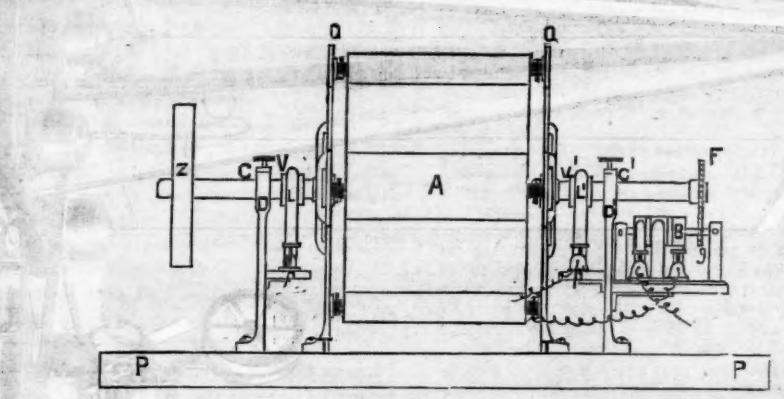


FIG. 1.

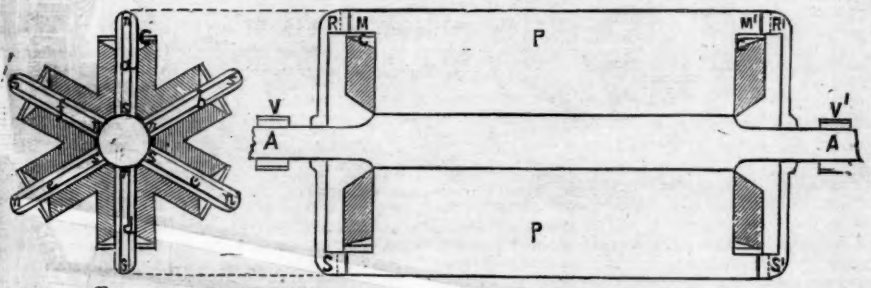


FIG. 3. FIG. 2.

follows :—The motor is formed of a multipolar electro-magnetic bobbin, placed in the axis of a fixed multipolar electro-magnetic apparatus (fig. 4); the frames, Q, T, and Q^1, T^1, keep the drum, A, and the electro-magnets together (fig. 1), whilst the supports, D and D^1, of the ends of the multipolar bobbins are solidly screwed on a strong base, P, P (fig. 1). At one of the extremities of the axis of the rotatory bobbin is fixed a pulley, Z, by means of which power is transmitted from the machine; at the other end of the axis a small toothed wheel, F, is fixed which actuates a commutator.

When an electric current circulates in the two parts of the motor, each of the poles of the rotatory bobbins become placed between two consecutive poles of the fixed apparatus, consequently each will be attracted by one and repelled by the other, for the magnetic polarity of the fixed poles are reversed alternately. Since the two forces are in the same direction, they assist each other, and as the magnetic reactions of all the extremities are also all in the same direction, the movable system is moved round by all the attractions and all the repulsions of

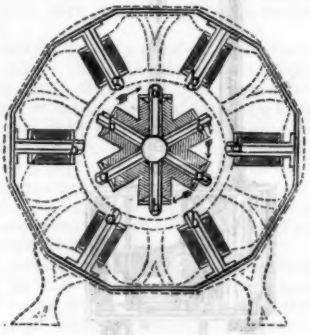


FIG. 4.

the apparatus. The poles of the movable bobbin tend to come to rest opposite the poles of the fixed bobbins, but the inertia of the mass carries them beyond this position, and, moreover, the current circulating in the bobbins is interrupted for an extremely short time at the moment when the movable branches pass before the fixed branches. The current in the multipolar movable magnet circulates always in the same direction, but is reversed in the fixed magnets each time that a movable bobbin passes a fixed one. This reversal of the current is effected by means of the commutator.

The magnetic actions exert themselves at a large number of surrounding points, and consequently the arrangement is very favourable to produce a good effect, especially as the attracting and repelling surfaces are of great length. Moreover, it is well known that the intensity of the magnetic attractions and repulsions is inversely proportional to the square of the distance. Now this distance being always very small in the De Geyter apparatus, in consequence of the multiplicity of the poles, it follows that the actions are exerted always under very favourable conditions. Still more, there is an advantage which is not met with in any other motor, namely that all the electro-magnets act usefully, not merely one at a time, but all together; no portion of the magnetic actions is lost, whilst in all other systems these forces are only utilised to a partial extent in doing work.

In order to make the machine work, it is only necessary to send an electric current through the insulated wire of the two portions of the apparatus, and to stop it the circuit has merely to be broken. The stoppage thus obtained is not instantaneous, but it can be made so by employing a Rhumkorff commutator, or other means of reversing the current in the rotary bobbins without altering that in the fixed ones. The movable extremities then repel the fixed poles as they approach them, and attract as they recede. They thus act in the reverse direction to that in which the machine turns, and consequently must arrest its action. The reverse current thus used should not be allowed to circulate for any length of time, else the motion becomes reversed instead of merely arrested. The machine once set going always runs with a uniform velocity as long as the work done does not alter; this

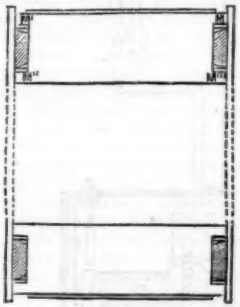


FIG. 5.

velocity can, however, be modified at will by means of a rheostat inserted in the circuit.

It may be remarked that the De Geyter machine can be employed as a current generator, but its principal use is as an electric motor. There are several reasons why the latter use is the more preferable of the two: the rotatory bobbins which are employed possess all the qualities of the Siemens bobbin, and have besides several advantages over the latter; in fact, with the same quantity of electricity the power obtained with the De Geyter bobbin is stated to be much greater than that from the Siemens. The latter cannot give as good results, since its dimensions are necessarily restricted; if it were constructed of a great size, the acting distance of the poles would become too great to give a good effect; if, on the other hand, it were made small, then the time for the magnetisation to become effective would be too short. In the De Geyter machine it is possible to adopt large dimensions, without inconvenience nor loss of power, for the arrangement is not limited to six branches, but can have as many as necessary, in order that the pull between the poles may be at as short a distance a possible.

THE GÜLCHER ELECTRIC LAMP.

The Gülcher electric lamp, which is shown by figs. 1 and 2, is distinguished by its simplicity. Its action depends on an almost forgotten principle of regulation, that of the magnetic pressure-brake; this principle has been applied very successfully. The novel and ingenious arrangement of the lamp is as follows, (fig. 1):—The upper and lower carbon holders

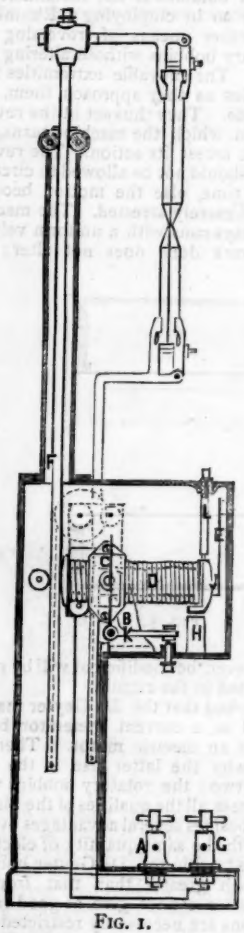


FIG. 1.

are connected together by means of cords. The upper holder, F, made of iron, moves in front of an electro-magnet, D, which revolves on C. The two polar surfaces of the latter are rounded in circles whose centres lie in C. By means of a spring, the tension of which is regulated by the lever, K, the electro-magnet is pressed against the peg, L. When a current passes through the lamp the one pole of the magnet holds the rod, F, fast, and the other is drawn downwards by the iron, H, fixed to the case, thus producing the luminous arc. As the carbons burn away, the magnet, D, is pushed back again by the spring, and finally is brought close to the peg, L, where under normal circumstances it remains quiet during the whole time of combustion. If in consequence of the further consumption of the carbon rods the current is weakened, the magnet, D, lets the rod, F, go, and

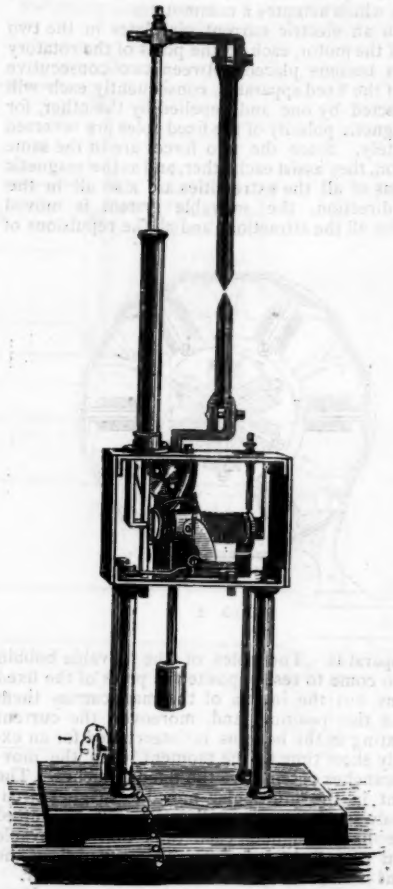


FIG. 2.

the carbons approach each other. In order to prevent the movements of the electro-magnets being too violent on lighting the lamps, or under other abnormal circumstances, the regulating pole of the electro-magnet is provided with a small magnetic brake, J.

The Gülcher lamp acts so well that no fluctuation of the light is perceptible. Fig. 2 shows the new model of the lamp in elevation.

The arrangement of the lamps in the circuit is the most remarkable feature in the whole system. We see here for the first time an automatic regulator which without differential bobbins, &c., can be applied to the production of several lights from a single source of electricity. If we suppose two of the lamps above-described introduced in a parallel position between the poles of a source of electricity it will be plain that the one lamp regulates the other. Let lamp, A, be kindled by closing its circuit, then when the second circuit of the lamp, B, is closed the main current (which is rendered stronger by the double closing) is divided into two branches. The branch which flows through the lamp, B, is stronger than that of A, because in B the carbon points touch each other, and the resistance in this branch is feebler than in the other. As a consequence, the lamp, B, is brought into action by the energetic action of the electromagnet, which withdraws the carbon points from each other, whilst in lamp, A, in consequence of the decrease of this branch of the current the carbon points are approximated, and so the light is rendered stronger. Thus each lamp regulates the other and consequently itself, so that in a very short time they are brought into complete equilibrium.

The advantages of a good parallel circuit arrangement and of the application of currents of great quantity are, that the light produced is of a yellowish or white colour without the violet or blue cast of the light of currents of high tension; the regulators on account of their simplicity can be produced cheaply, and any number of the lamps can be extinguished and rekindled without affecting the rest. The attention required for the lamps when in use, and even contact with uncovered parts of the conduction, is free from danger.

The arrangement for effecting an equal distribution of the current among the lamps is as follows:—As soon as the number, n, of the lamps to be supplied from the machine is known and the total length of the conductor, the diameter, D, of the conductor for the total current is calculated. Then a diameter, d, is calculated according to the formula,

$$\frac{\pi D}{4} = \frac{n \pi d^2}{4} \text{ or } d = D\sqrt{\frac{1}{n}}$$

and a cord is formed of n wires of the diameter, d, the section of which taken together is equal to the section of a single wire of the diameter, D. This cord is connected with the one pole of the source of electricity (*e.g.*, the positive), and led to the first lamp, where one wire branches off, passes through the lamp and is then led on parallel to the remaining $n-1$ wires; at the second lamp a second wire branches off from the cord and after it has passed through the lamp is united with the wire coming from the first lamp. Going on in this manner the whole of the wires are at last united together again in a cord of n wires which returns to the negative pole of the source of electricity. In this manner the resistance for each lamp is of the same value.

The "Gülcher dynamo machine" is almost identical in principle with the "Schuckert" (see TELEGRAPHIC JOURNAL, April 1st, 1879), and the differences which exist between the two are hardly, we think, in favour of the former.

THE BRITISH SECTION.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY.

We are compelled to leave, until our next issue, through an accident to the manuscript, the continuation of the notice of this company's exhibit.

ON THE PRACTICAL MEASUREMENTS OF ELECTRICAL MAGNITUDES.

By W. H. PREECE, F.R.S., Electrician to the General Post Office, London.

1. ALL our ideas of magnitude of any kind are simply conceptions of the comparison of some well-known magnitude with that whose dimensions we wish to estimate. Painters invariably put living figures into their pictures, to enable the spectator to form some conception of distance, by comparing the well-known human forms with trees, valleys, or hills. The human form thus becomes a rough standard of reference. But the engineer and the physicist must be exact; their standards of reference must be something fixed and determined. Questions of *distance* are determined by reference to the "metre" or "foot;" questions of *mass* to the "gramme" or "pound;" questions of *time* to the "hour" or "second." Every accurate system of measurement means the direct comparison of the magnitude to be measured with another *of the same kind* and of given determined dimensions, which becomes, for that kind of magnitude, the *standard of reference*, and to which a distinguishing name is given.

2. The relative magnitude of the quantity to be measured and its standard of reference is the ratio of the undetermined to the determined magnitude, and this, in fact, is its *numerical value*, for it indicates the number of times the first magnitude contains the second. Hence the standard of reference is the "unit," for in any numerical comparison it is indicated by 1, or unity, while the other quantity is indicated by the number of times this named unit is contained in it.

If we have two distances, the one of which we will indicate by D and the other by d, their relative magnitude is expressed by the ratio $\frac{D}{d}$ and if we make d one metre then the ratio becomes $\frac{D}{1}$ or simply D, D being the numerical value or the number of metres contained by the distance to be measured.

3. It is customary to express physical quantities of all kinds by letters of the alphabet, but it is important to bear in mind that letters can only be used where the quantity represented can be arithmetically represented by a number. Letters, in fact, simply represent numerical values. When we say "let the time be T," we use T in place of some undetermined arithmetical number of units—seconds or minutes, or hours, as the case may be; or, when we say, "let the mass be M," we mean M grammes, or pounds, or tons, as the case may be, M being any number whatever. We cannot measure one physical quantity by the units of another physical quantity; we cannot measure distance by seconds, or mass by metres. Hence when we express any physical law by an algebraical equation, such, for instance, as Ohm's celebrated law—

$$C = \frac{E}{R}$$

where C represents the current of electricity flowing, E the electromotive force or the power producing it, and R the resistance or obstruction to its flow.

We can make no use whatever of such an equation, unless we can give numerical values to these letters which have reference to the same system of units. If E be measured in terms of the cells of a given battery, and R in terms of some given length of wire, the result is valueless as an exact arithmetical expression of the value of C. Without a definite and determined system of units, algebraical formulæ like the above are mere shorthand expressions of physical laws and facts; with such a system they can become capable of comparison and measurement. Without a proper system of units the formula—

$$C = \frac{E}{R}$$

simply expresses the broad fact determined by Ohm, that a current of electricity varies directly, as the electromotive force producing it and inversely as the resistance opposing its flow. With a proper system of units we can *express and measure exactly* the currents flowing when we change either the electromotive force or the resistance.

4. There must be as many different units as there are different kinds of magnitudes to be measured, but there are only three arbitrary units which by mutual consent have to be accepted as fixed or determined, and these are usually *the mean solar second*, the *metre* and the *gramme*, each of which admits of direct comparison, precise measurement, simple reproduction, and easy verification.

It happens that physical and dynamical quantities, such as those that enter into electrical questions, can be expressed in terms of either or all of these units of time, space, and mass. Hence these units are called *fundamental*.

Any system of measurement based directly on fundamental units is said to be "*absolute*," a most unfortunate name which means nothing, and which alone has tended to deter many from endeavouring to comprehend a system that is not only necessary, but is really simple.* *Invariable* would have been a much better title than absolute, for the second, metre, gramme once having been determined upon are fixed and invariable. *Dynamic* would have been better still, but *absolute* is however an accepted term, and the system of units derived directly from these fundamental units of length, mass, and time is said to be the *metrical absolute system*. An absolute system is not confined to the metre, gramme, and second. The fundamental units may be the *foot*, *pound*, and *second*. Such a system is called the British absolute system. Indeed, the units of length, mass, and time may be anything we please, but they must remain invariable for that system.

5. Force was defined by Newton as that which produces or tends to produce motion. In gravity, electricity, and magnetism, it takes the form of attraction or a repulsion. Thus bodies fall towards the earth, through the mutual attraction of the earth and the body. Bodies *oppositely* electrified approach each other through their mutual attraction, and *similar* magnetic poles repel each other through their mutual repulsion. Now the magnitude of these forces of gravity, electricity and magnetism can be measured by the rate at which bodies effected by them would move if free, or, in other words, by the space they would pass over in a given time. Thus gravity is found to exert a force in a body in the neighbourhood of Paris free to fall which at the end of one second would generate a velocity of 9·81 metres per second. Forces are therefore measured by the velocities they impart to bodies on which they are impressed. A velocity is length passed over in a given time. One metre passed over by one gramme in one second would be the result of unit force. Hence unit force is defined as that force which if applied upon a gramme for one second generates a velocity of one metre per second. In this sense gravity is a force which equals 9·81 times "absolute" force, for it generates at the end of one second a velocity of 9·81 metres per second. If the motion of a gramme mass under such a force be resisted, we have a pressure analogous to *weight*, weight is the measure of the force of gravity upon matter. Thus the weight of unit mass is 9·81 metrical absolute units of weight.

If the resistance of a force be overcome, if, for instance, a kilogramme be raised perpendicularly one metre high against the attraction of gravity, or if two similar magnetic poles be pressed towards each other against their mutual force of repulsion, something has been accomplished—in other words, work has been done. The power of doing work is termed *energy*, and the amount of energy expended is measured by the distance through which a force acts. Thus unit of work or of energy is defined as that done by unit force acting through unit space. One kilogramme raised one metre is called a *kilogramme-metre*, and it is equivalent to 9·81 metrical absolute units of work. The common unit in England is called a *foot-pound*, which is $\frac{1}{7\cdot23}$ of a kilogrammetre.

Energy expended in any other form than that of useful work usually takes the form of heat. Thus the presence of heat is not only an indication of the expenditure of energy, but it is another measure of the amount expended.

This metrical absolute system has, however, certain inconveniences of a practical nature attached to it which have forced physicists and engineers to modify and simplify it for ordinary use. The metre has been found too large, and the centimetre has been adopted instead, as the unit length. Hence we have a system modified from the metrical absolute system which for brevity is called *the c. g. s. absolute system*; c. g. s. being the initials of centimetre, gramme, and second.

In this c. g. s. absolute system the unit of force is called *the* "*dyne*," and the unit of work and energy, *the* "*erg*." The chief reason that led to the acceptance of the centimetre is the simplification it introduces in indicating the numerical value of the densities of different materials. In this system the specific gravity of water and its density are the same, while in the metrical absolute system, the one is one million times the other.

6. Several other absolute systems have been suggested. The Committee of the British Association, in their original scheme, adopted as unit length one earth quadrant (10,000,000 metres), as unit time:—one second;—as unit mass:—the thousand-millionth part of a milligramme. Weber adopted the millimetre as unit length, and the milligramme as the unit mass. But the c. g. s. system has now been very generally adopted, and it is hoped that it will become international and therefore universal. It expresses in definite and uniform measure all the dynamical relations of the physical forces. It is a scientific and natural system, embracing the conception of work. Hence it should be called the *dynamical system of units*. The numerical values obtained are the same in whatever country the observations are made, and they are independent of the apparatus used. It has thus bound together in one homogeneous whole all the sciences, and the units

* The term absolute was introduced by Gauss in his celebrated Memoir of 1832; "Intensitus vis magnetriæ terrestris in mensuram absolutam revocatis," to indicate that this system of measurement was independent of any kind of instrument and of gravity.

of force and energy are the golden bands that have effected this desirable union.

The immense advantage which such a system offers, besides its independence of instrument, is the abolition of numerous co-efficients, and the laborious calculations that they entail, which are required to express magnitudes in the language and system of one country, and to translate them to that of another. The almost universal acceptance of the French decimal system has not only paved the way for this desideratum but has rendered it practical and possible. The confusion that arises in comprehending the various national systems for representing lineal dimensions, scales of temperature and weights have only to be experienced to be condemned.

7. Fortunately in electricity there was no system to be superseded, for none existed. It only needed a proper absolute system to be proposed for it to be adopted; but even now a practical system remains for consideration, for the c. g. s. absolute system is not universal, nor is the nomenclature general even in England.

8. An absolute system of units, pure and simple, though theoretically perfect, is, unfortunately, not practical without modification. A system has to be derived from the absolute system to make it practical. With any system there must be excessively large and excessively small numbers, and the selection of any particular derived system is in reality the choice of evils. For instance, the absolute unit of electrical resistance is so small that it is far below the reach of our apparatus, and to make it practical, or to bring it within the sphere of our instruments, we have to multiply it one thousand million times. Again, one English foot-pound is 13,560,000 times the c. g. s. unit of work.

Hence, large numbers have to be used; but the inconvenience of using such numbers is very much diminished by writing large numbers with two factors, one of which is a power of 10. The index 10 represents the power of 10, or the number of cyphers that follow the first figure, 10^5 means 1 followed by 5 cyphers. Thus, the above relation of the unit of work would be indicated by $13{\cdot}56 \times 10^6$ c. g. s. units. The practical unit of electrical resistance, or the *ohm* as it is called, is 1,000,000,000, or 10^9 c. g. s. absolute units of resistance, while the practical unit of capacity is $\frac{1}{1,000,000,000}$ or 10^{-9} c. g. s. absolute units of capacity. The difference between the metre and centimetre is only the difference between the index of the power of 10, and all the principal units of electrical measurement which involve powers of 10. Thus $9{\cdot}81 \times 10^2$ is the acceleration of gravity in centimetres; it would be $9{\cdot}81 \times 10^3$ in millimetres. The quadrant of the earth is 10^7 metres, and the metre is 10^7 of the quadrant of the earth. One "horse-power" is 7,460,000 ergs per second, and is written $7{\cdot}46 \times 10^9$ ergs, while the "force de cheval" is $7{\cdot}36 \times 10^9$, or 7,360,000,000 ergs per second.

9. Every absolute system based on fundamental units of length, time, and mass is easily convertible from one to the other, when we know the ratio that determines the change from one unit to the other of the same kind. The equations expressing these ratios are termed *dimensional equations*. The theory of dimensions or the laws according to which derived units vary when the fundamental units are changed, was developed by Fourier in his *Théorie de chaleur* (§ 160). Their discussion here is not necessary to our purpose. Their introduction in fact very much complicates the explanation of the meaning of any system of units.

(To be continued.)

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this Society was held on the 10th inst., Professor G. CAREY FOSTER, F.R.S., president, in the chair. The minutes of the last general meeting, held in London on the 26th May, and of the extraordinary meetings held in Paris on the 22nd and 24th September, having been read and confirmed, a paper was read by Mr. JOHN LUND (of the firm of Barraud and Lund, Cornhill), on "Synchronising Clocks by Electricity."

The author commenced by saying that the subject he was about to bring forward was unlike any that had yet been introduced before the Society; he was not about to lay down any new law, or to explain an entirely new invention, but simply to show a development of a principle which was old, and which he had for four years worked in order to render a practical success. The records of the Patent Office show that the general problem of the synchronising of clocks by electricity had been worked at for a lengthened period, and indeed at a certain time occupied a very great amount of attention. He divided the methods which had been employed in attempting a solution of the general problem into six heads:—1st. Clocks whose motion was produced by the electric current and which had no pendulums; an example of this was seen in the Shepherd clock which had been empolyed for some time at the Royal Observatory, Greenwich. 2nd. Clocks with pendulums driven by the electric current, Ritchie's, for instance. 3rd. Clocks with spring or weight power, in which the pendulum was controlled by the current. 4th. Clocks of the ordinary type which were given a gaining rate and whose minute or second hand was arrested when it arrived at the mark indicating the hour and was released exactly at the hour by the electric current. 5th. Clocks of the ordinary type whose hands were set at the hour by means of a V piece acting on a pin fixed to the hand, or *vice versâ*, the V piece, or pin, as the case may be, being actuated by the electric current. 6th. Clocks of the ordinary type set to Greenwich time by special contrivances. To Bain undoubtedly belongs the idea of thus setting clocks to time, although he did not succeed in getting the mode adopted.

Roughly speaking, synchronising methods may be divided into three heads, viz., 1st, clocks driven; 2nd, clocks controlled; 3rd, clocks set, by electricity.

Although, in a certain sense, all attempts up to within the last few years to solve the problem may be called failures, yet, strictly speaking, they were not so, inasmuch as a great deal of work was accomplished which was quite necessary before entire success could be achieved. Wheatstone's method was tried for some time, but failed eventually, and he did not believe that more than five or six clocks were ever included in the circuit. The failures, he considered, were due to the fact that the clocks were made subservient to a system, when the reverse should have been the case. What then was the proper system? In the first place, the clock must be entirely independent of any synchronising system which might be applied to it; secondly, the system should be easily adaptable to any existing form of clock; thirdly, the system should correct the clock, whether it had gained or lost. To synchronise the clock by giving it a gaining rate, he considered quite absurd; for practically, the clock could never be correct, except exactly at the hour; whereas, by adopting

the method of correcting for either rate, the clock could be adjusted so as to give as nearly as possible correct time, it being a matter of no consequence whether the adjustment was a little out either way.

With regard to synchronising generally, a distinction must be drawn between the *mode* of synchronising and the *system*. Till lately no person has got beyond the *mode*, whereas to make the idea a practical success a *system* must be arranged. The author contended that his own system fulfilled all the criteria necessary for complete success. It was extremely simple, it could be applied to any clock without difficulty, and was quite independent of the general mechanism of the time-piece. The whole synchronising mechanism was self-contained.

As regards the mode of fixing the mechanism, the question arose, should it be fixed to the wood case or the metal frame? The proper way was, undoubtedly, to fix it to the frame or dial plate. There arose then the difficulty of getting the synchronising pins, which were employed in his system, to clear the glass; to avoid this, the pins were set away from the extreme edge of the dial, and more towards the centre; as the hand could not, under these conditions, clear the pins if the synchronising was done in the ordinary manner, the pins were made short and a small block set behind the hand, against which the pins acted. A great deal of difficulty was found from the fact of the synchronised hand being loose on its axle; this required special attention, as, for accuracy, the hand should be absolutely tight. To attain this, the minute hand spring required to be made springy instead of stubborn, as was usually the case.

As regards the whole system generally, it was very necessary that it be complete, that is to say, the wires should be properly arranged. Gravity escapements were not necessary, the ordinary Graham dead-beat answering every purpose.

The time being given by a standard clock, it was found at first that the latter might fail from being accidentally allowed to run down. This difficulty was overcome by employing two clocks which were wound on different days. As a breakdown of one or other of the clocks required to be corrected, two indicators are employed which, on a failure taking place, at once indicate which clock was in fault. A third clock shifts the circuit from one clock to the other periodically, so that whichever happens to fail the other will be certain to give the signal.

To enable it to be known whether the standard clock was right, an arrangement was adopted by which a small mark was made of a dial by the action of the Greenwich current; this marked showed the position of the hand of the standard clock.

The correction of the standard clock from time to time was a matter of some difficulty. An arrangement had been tried by which small weights were dropped or taken off the pendulum so as to decrease or increase its rate of swing; this device was, however, only partially successful. Sir George Airey had accomplished the requirement by making a coil on the pendulum pass over a permanent magnet; by closing the circuit of the coil the action of the magnet was to check the rate of swing.

To point out how successful his system was, he would say that 3½ millions of signals were sent out on 12 circuits every year, and with great regularity. His system extended to every part of London.

For the purpose of distributing the time signals, he used a simple form of chronofer, with twelve contact springs. He found there was no difficulty in making good contact with these springs, although he had been told that this difficulty would be experienced. It was discovered that it was not necessary to clean the contacts, as they practically cleaned themselves; and as to the burning away of the contacts, he found the best plan was to go on working till they were completely burned through, and then to renew them.

Very little difficulty was experienced from lightning, as his experience showed that a wire with one end disconnected was rarely damaged.

Mr. LUND then proceeded to describe his testing system, which was of a very ingenious character, the state of the line (as regards an actual break) being reported by a clock, which put a current on each line successively through an indicator, the latter moving over to "line right" if there was good continuity, but remaining at "line broken down" if the current could not pass, owing to a break.

In cases where a visible signal was required to note the exact hour, he employed a red disc, which turned round and displayed its face for 15 seconds at the exact hour.

The use of small time-balls, he thought, had not found favour because they were either expensive or required to be pulled up each time they were required to be dropped. He showed a specimen of this form of time-signaller, in which the ball was wound up by a clock-work train, which became stopped when the ball was fully raised and set. This apparatus would work for three months without requiring to be rewound.

With reference to successes which he had had, he might mention that the Dumbarton time signal, which had been in use for three years, had never failed. London, he said, had now the largest system of electric time distribution in the world.

In the discussion that followed the reading of the paper,

Sir CHARLES BRIGHT described the system of R. L. Jones invented in 1855. In this system the pendulum was synchronised at each beat; this system he considered the best of those which were *continuously* synchronised. The arrangement was tried some years ago in Liverpool, and was very successful.

Mr. STROH asked whether, in addition to setting the hands, some arrangement had not been tried for altering the length of the pendulum at the time the synchronising took place, so that by continual correction, the clock would eventually neither gain nor lose.

Mr. COFFIN said that some years ago at the Stevens' Institute in America he had attempted to solve the problem referred to by Mr. Stroh, but the experiments were only partially completed; in the arrangements he had worked at he had endeavoured to make the amount of correction for the pendulum, to be proportional to the amount of error from the correct going rate.

Mr. CRISBECK said that at the Royal Observatory, Greenwich, the difficulty about contact springs sticking together was got over by using a shunt between the two contacts.

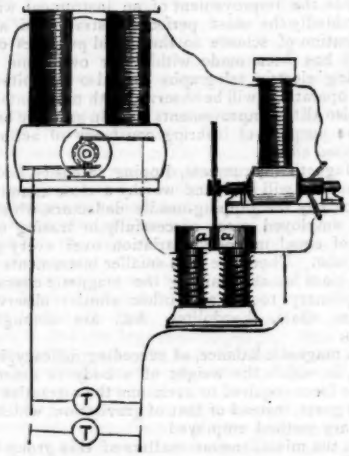
After a reply by Mr. Lund, the meeting adjourned till the 24th, when a paper will be read by Sir CHARLES BRIGHT and PROFESSOR HUGHES on "The Paris Exhibition."

THE COMPAGNIE GÉNÉRALE D'ELECTRICITÉ OF PARIS.—This Company now owns the French patents for the Jamin, Jablochkoff, Jaspar, Werdermann, and Maxim lights; and also for the Gramme Machines.

THE CROMPTON AND SWAN ELECTRIC LIGHTS.—A portion of the London Mansion House is to be lighted by Messrs. Crompton & Co. with the Crompton arc and the Swan incandescent lamps.

Notes.

A CURRENT REGULATOR.—A patent (No. 248, 421, dated March 5th, 1881), has been taken out in the United States, by Mr. Edison, for a "current regulator for dynamo-electric machines. This arrangement, which is shown by the figure, consists in the combination



of a generator, an electro-motor in the field-magnet circuit, carrying a disc upon its rotating shaft, and a magnet in the supply-circuit in whose field the disc rotates, whereby the rate of the motor and the strength of the field-circuit are varied and controlled.

ON THE INFLUENCE OF THE TENSION AND THE VIBRATIONS OF A WIRE UPON ITS ELECTRIC CONDUCTIVITY.—By L. De Marchi.—The experiments were conducted with a differential mirror-galvanometer in both the parallel conductions of which were introduced two parallel wires suspended vertically, one of which was stretched or set in vibration. In experiments with wires of steel, copper, iron, and brass, it appeared that every stretching increased the resistance, only in very feeble stretchings a decrease was sometimes observed. The increase of resistance is in general proportional to the increase of the tension, though the former bears no simple proportion to the elongation. Every vibration affects the resistance, increasing it in general when a sound is produced, but otherwise decreasing it.—*Wiedemann's Beiblätter.*

INCANDESCENCE *versus* ARC ELECTRIC LAMPS.—We hear from various sources that the Incandescence lamps have been so far improved that they can be made to give a light exceeding 600 candle-power without breaking the filament; this being the case, and in view of the further improvements which are certain to take place, it seems highly probable that the days of the Arc lamps, for general lighting purposes, are numbered. It is a fact that many of our most eminent electricians, who are acknowledged authorities on the Electric light question, and who in the first instance strongly argued in favour of the Arc system, have now as strongly declared against it in favour of the Incandescence principle.

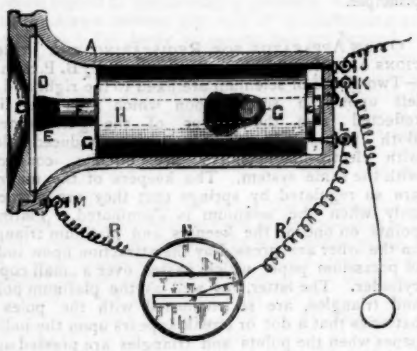
ON AN APPARATUS FOR REGISTERING THE INDICATIONS OF A MIRROR-GALVANOMETER.—By B. P. Samuel.—Two pieces of selenium are fixed to the right and the left upon the screen upon which falls the light reflected from the mirror of the galvanometer. Both pieces of selenium are introduced along with electro-magnets, in two circuits, connected with the same system. The keepers of the magnets are so regulated by springs that they are attracted only when the selenium is illuminated. Platinum points on one of the keepers and platinum triangles on the other are pressed by the attraction upon iodide of potassium paper which passes over a small copper cylinder. The latter, as well as the platinum points and triangles, are so connected with the poles of batteries that a dot or streak appears upon the iodised paper when the points and triangles are pressed upon it.—*Wiedemann's Beiblätter.*

MAGNETS.—With a view to ascertaining the best steel for the manufacture of magnets, determining the most effective degree of hardening to be given to it, and choosing the most simple and practical method of rendering it magnetic, M. Trouvé has made a series of experiments. He has cut bars of steel lengthwise, magnetised them, measured their power, and then has hardened them and again magnetised them. After again measuring their power, he has found that it was increased, so that a magnet, after the second magnetising, will bear a weight which is expressed by the square of the weight it was first able to carry, so that if it had a power of 2, 3, or 4, after the first operation, its capacity would be increased to 4, 9, or 16 respectively after the second. Hardening must be very regular, and manufacturers of steel for this purpose should do the heating in a muffle heated by gas. In order to magnetise, M. Trouvé places the steel bars into two solenoids in juxtaposition, closing the magnetic circuit by means of two plates of soft iron. For generating the current, he employs a battery of six Wollaston cells. In this way M. Trouvé has obtained magnets having a uniform power, his rod magnets carrying as high as 12 and even 14 times their own weight, while with horseshoe magnets it will rise to 48 or 56 times the weight.—*Engineer.*

THE ELECTRIC LIGHT AT CHESTERFIELD.—The trials of the Brush electric light at Chesterfield have been so successful that the corporation have decided to dispense with gas entirely, as far as public lighting is concerned, and to replace it with the electric light. The contract has been secured by Messrs. Hammond & Co., of 110, Cannon Street, London, the general agents of the Brush Company. The lighting will be done by means of about twenty-two Brush arc lamps, and about seventy Lane-Fox incandescent lamps. The annual cost of same is guaranteed by the contractors not to exceed the present gas bill, and it is claimed that the light will be three times as efficient. Deputations have visited Chesterfield from Derby, Nottingham, Barnsley, Sheffield, and other towns, who are now in negociation with the contractors for a trial of the Brush light.

A NEW TELEPHONE.—Mr. J. Milton Stearns has taken out a patent (No. 248,116), in the United States, for the form of telephone shown by the figure. The

arrangement consists of an induction-coil (the primary wire, G, of which is electrically connected to the core, F, and the secondary wire with the line, O, and earth),



a core, F, cushion E, diaphragm D, wire, R, R, and battery, N, as shown.

THE EDISON ELECTRIC LIGHT.—An offer has been made to the Corporation of the City of London, and has been referred to a committee, to light the Holborn Viaduct for two months with Edison incandescent lamps free of charge. The intention is that the houses within a convenient distance shall be supplied with electricity by meter for domestic use.

ELECTRICITY AT THE GREAT EXHIBITION OF 1851.—As a contrast to the immense display at the Paris Exhibition, it is interesting to note the state of electric science as exemplified, three decades ago, at the Great Exhibition of 1851. The following extracts are taken from a synopsis of the official catalogue of the latter exhibition, and are the entire references to the exhibits of the electrical class:—

"Engraving by electricity is a new art, of which examples are shown. The process is to connect the steel plate with one pile of a galvanic battery, and the engraver, a mere metal point, with the other; this is held by means of a glass or ivory handle. Every time the two are brought into contact there is a spark, a small portion of the steel undergoing combustion; therefore the engraving is a series of dots produced by the combustion of the steel effected thus by the agency of the voltaic current. This process is more applicable to steel than to any other material.

"We then have the arrangements for the electric light exhibited, showing how the charcoal poles, or points, between which the light is developed, are maintained at a uniform distance from each other, during the operation of the electric current. The attempts made, hitherto unsuccessfully, to apply electro-magnetic force as a motive power, also receive illustration. The great difficulties are, the loss of power through space, and the setting up of a counter current, acting as an opposing force the moment motion is produced.

"Electrotypes and electrotype apparatus will be found of considerable interest, most particularly some very delicate specimens of flowers, &c., covered with copper, by the process. A film of silver is first formed on the article, whatever it may be, by dipping it in a solution of phosphorus in sulphuret of carbon, and then into a silver solution; after which, it is connected with the voltaic battery.

"Compasses of various kinds, with many of the most approved and the newest arrangements, for preserving these instruments as free as possible from vibration at sea, are exhibited. Near these some electrical machines will be found; also a very powerful steel magnet, constructed on the principle recommended by Dr. Scoresby, and some cast-iron magnets, of much power, which can be readily made at small cost.

"Of electric telegraphs, and machinery connected with them, there are between twenty and thirty exhibitors. We have here the ordinary double-needle telegraph, and all the numerous modifications of that instrument which have been introduced. Many of the contrivances are most ingenious, and all more or less tend towards the improvement of an instrument which is undoubtedly the most perfect illustration of a grand application of science to the useful purposes of man which has been made within our own time. The printing electric telegraphs are also exhibited, and their operations will be observed with much interest, as will also all the improvements made in galvanic batteries for the purpose of insuring constancy of action, and increased effect.

"Magnetic instruments, dipping, intensity, and variation needles will be found worthy a close examination, particularly the dipping-needle deflectors, which have been employed most successfully in tracing out the lines of equal magnetic variation over every part of the globe. There are also smaller instruments of the same class for ascertaining the magnetic character of the primary rocks, and other similar observations. Miners' dials, theodolites, &c., are amongst this group.

"A magnetic balance, of exceeding delicacy, is exhibited, in which the weight of a body is determined by the force required to overcome the attractive power of magnets, instead of that of gravitation, which is the ordinary method employed.

"In the miscellaneous matters of this group will be found many arrangements connected with the applications of gutta-percha as an electrical insulator, and its use in the form of tubing for communicating from one apartment of a building to another with facility, and many mechanical and electrical contrivances of exceeding ingenuity.

"The Electric Clock marks the centre of the transept. The clock is worked by the magnetic power imparted to bars of steel by the electric current generated by the chemical action in a Smee's battery. It will be observed that the pendulum beats in unison with the attraction and repulsion of steel bars opposite the ends of the magnet; when connection is established, the reduced magnetism frees the pendulum from the action of a spring, and thus a uniform rate of oscillation is obtained. This is communicated to the hands by simple machinery, and may be conveyed to any number of dials by very simple adjustment."

NEW CABLES.—The *International* left the Thames on the 9th inst. for Mexico. She has on board the first section of the Central and South American Telegraph Company's cables. The section is composed of an intermediate type of cable, and will be used to connect Vera Cruz with Goatzacoaleos. This, in conjunction with the Vera Cruz, Tampico, and Tampico-Brownsville Cables of the Mexican Telegraph Company, will put the States in direct telegraph communication with the Atlantic side of the Isthmus of Tehuantepec. A land line of some 200 miles will carry the messages to the Pacific side at Salina Cruz, and then the cables continue as follows:—Salina Cruz to San José de Guatemala, San José to Salinas Bay, Silinas Bay to Panama, Panama to Buenaventura, Buenaventura to Santa Elena, Santa Elena to Payta, and Payta to Chorillos for Lima Peru. At Chorillos the Central

and South American Company's system will join the West Coast of America Telegraph Company's lines to Valparaiso. The completion of these lines will, with the existing lines on the east coast of South America, practically duplicate the telegraph communication between the United States and England and the capitals of Brazil, Uraguay, Buenos Ayres, Chili, Peru, and Ecuador. Should the Tampico-Vera Cruz section be interrupted, telegraph communication with the United States could be made *via* Valparaiso and the Brazilian Submarine Company's lines, and then on through the Anglo Company's lines. If the Lisbon-Madeira section of the Brazilian Submarine Company's line fail, Madeira could communicate telegraphically with Europe by sending *via* Pernambuco, Buenos Ayres. Valparaiso, and north through the new lines to the States, whence communication with Europe is excellent, In fact the new lines will make a perfect duplication of the existing lines by filling up a gap in the circle.

ACTION AGAINST A CABLE COMPANY.—In the High Court of Justice, Chancery Division, before Sir C. Hall, the case of Harold *v.* The India-rubber and Gutta-percha Company was mentioned. This was an *ex parte* application for an interim injunction to restrain the defendant company from laying or shipping for transmission abroad a certain submarine cable. The plaintiff in 1879 and 1880 obtained a concession from the Governments of Columbia, Peru, and Ecuador to lay a cable which was to extend from Guaguile to Lima. It was intended that the telegraph lines should join at Callao, in Peru, with the coast telegraph in Valparaiso and the Argentine Republic. The concession was for 25 years. It, however, had recently come to the knowledge of the plaintiff that the defendant company were about to ship a submarine cable, to be laid in the route which had been conceded to him and his associates exclusively. If the defendants' cable were laid it would entail a serious loss and injury to him. Mr. Graham Hastings, Q.C., appeared for the plaintiff. The Vice-Chancellor said he could not grant an injunction restraining the company from making or shipping this submarine cable, but he would grant an injunction restraining the company from laying or working the said cable. The plaintiff, however, would have to give the usual undertaking as to damages.

Correspondence.

ELECTRIC LIGHT.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Your correspondent "Electron" seems to have misunderstood my letter of the 1st ult., the point of argument being as to whether the 20 horse-power engine was able to light only 40 incandescent lamps. I did not intend to convey the idea that more light was got per horse-power by the incandescent than by the arc light. Indeed those who have studied the subject at all, know that the incandescent light comes far behind the arc when the total amount of light obtained per horse-power is taken into consideration. Since writing my former letter, the incandescent lamp has been introduced into some of our large Manchester firms, where it has been put up, not so much with the object of competing with gas, as that coloured goods may be identified and matched as readily as in daylight. In every instance it is well spoken of. Surely this is a proof of its illuminating power. I can assure "Electron" that the firms I allude to have carefully considered the whole matter. One of them indeed sent a gentleman over to the Paris Exhibition to thoroughly test the utility of the incandescent light for their purpose. Manchester people are not given to spending money on any useless novelty that may be introduced.

Many besides myself would be glad to know where a *full* description of the photometer referred to by "Electron" and used by the Board of Works may be obtained.

"Electron" seems to have a greater liking for the Jablochkoff system than other newer ones. A week or two ago when at the Paris Exhibition I very carefully observed the many and varied systems, and I came to the conclusion that the Jablochkoff certainly was not the whitest, purest, or most economical light. Although simple in itself, it requires a larger expenditure in extra cables than other English and American systems. Trusting that other readers may give "Electron" and myself the benefit of their experiences,

I remain, yours truly,

JOHN E. CHASTER.

35, Ward's Buildings, Deansgate, Manchester.
Nov. 4th, 1881.

New Patents—1881.

4771. "Improvements in the method of and apparatus for lighting by gas, parts of the improvements being applicable to lighting by electricity and for heating purposes." C. CRASTIN. Dated November 1.

4775. "Electric lamps." H. A. BONNEVILLE. (Communicated by L. Daft.) Dated November 1. *Complete*.

4777. "Electric lamps." E. R. PRENTICE. Dated November 1.

4778. "Incandescent electric lamps." F. WRIGHT. Dated November 1.

4780. "Improvements in insulating electric conductors and in the material employed for such insulation or for water-proofing purposes." A. F. WOODWARD. Dated November 1.

4781. "Improvements in insulating electric conductors and in the material employed for such insulation or for water-proofing purposes." A. F. WOODWARD. Dated November 1.

4792. "Improvements in switches or apparatus employed in connection with electric lamps for closing the circuit on the extinction of one of the lamps, and for lighting and extinguishing the lamps, which improvements are also applicable to other similar purposes." W. E. HUBBLE. (Communicated by J. M. A. Gerard-Lescuyer.) Dated November 2.

4797. "Telegraphic or telephonic cables and conductors." C. L. GORE. Dated November 2.

4812. "Apparatus for using electric lamps on locomotives and other vehicles." H. J. HADDAN. (Communicated by W. De Busscher,) Dated November 3.

4819. "Motors actuated by electricity." W. L. WISE. (Communicated by E. Bürgin.) Dated November 3.

4820. "Electric lamps or regulators." W. L. WISE. (Communicated by E. Bürgin.) Dated November 3.

4824. "Electric current meters." C. A. CARUS-WILSON. Dated November 3.

4825. "Means or apparatus for regulating dynamo-electric machines or other sources of electricity and electric motors." C. A. CARUS-WILSON. Dated November 3.

4830. "Improvements in and relating to boats to be propelled by gas or other motors contained therein, and in apparatus for controlling or regulating, by the aid of electricity, the propulsion, steering, and other operations required in working the same, which apparatus is partly applicable for other purposes." W. R. LAKE. (Communicated by J. L. Lay.) Dated November 3.

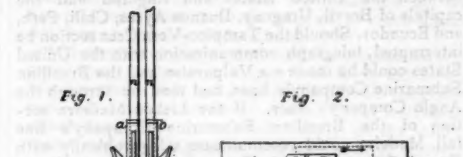
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

1206. "Electrical apparatus for automatically recording the times of signals given or received." R. R. HARPER. Dated March 19. 6d. Relates to improvements in electrical apparatus for automatically recording or registering the times of signals given or received, applicable for use on railways and for other registering purposes. A dial or drum of paper or other material is used in connection with and driven by an ordinary clock or time-piece and according as the clock is an eight day or daily clock, so is this dial or drum marked off on its surface into days, hours, or minutes, or only into hours and minutes. At a particular point of the said dial, face, or drum, an electro-magnet is fixed, and at this point the time marked on the said dial or drum is always the same as that indicated by the clock. This electro-magnet is actuated by an electric current caused to pass through it by reason of a contact-piece in or on the instrument used in signalling being brought into electrical contact, and so completing an electrical circuit. The effect of the passage of this current is to cause the said electro-magnet, by the sudden attraction of an armature or other action, to puncture (or mark with a pencil or pen, or with the current of electricity, as in Bains' chemical telegraphy) the dial or drum at the said point, and so mark the exact time at which the signal was given.

1232. "Electric lamps." H. E. M. D. C. UPTON. Dated March 21. 2d. Relates to incandescent electric lamps. The object of the invention is to provide for the automatic feed of the carbon in a simple manner. For this purpose the end of a vertical carbon is rested upon two studs or rollers, which are the terminals of the conductors to and from the lamp, the carbon bearing on those studs by its own weight and sinking downwards as its lower portion becomes consumed. The electricity passing from the one stud to the other through the lowest part of the carbon heats it to incandescence, thereby producing illumination. The carbon may be pressed against the studs by a weight or spring, and in that case it may be directed upwards or at any desired inclination. (*Provisional only.*)

1235. "Apparatus for electric lighting." G. A. TABOURIN. Dated March 21. 6d. Relates chiefly to a new mode of lighting a larger or smaller number of lamps from a common source. Instead of transmitting and dividing the energy required for lighting the lamps by means of cables and conductors of electricity, compressed air or other suitable fluid is used in the following manner:—An air compressor (if air is used) driven by water, steam, or other motive power, and a receiver for compressed air are placed at the distributing centre, from which air pipes lead to the various points where dynamo-electric machines are situated, driven by compressed air by means of a small Brotherhood engine or any other suitable pneumatic motor. A dynamo-electric machine driven by compressed air is used for every lamp or for every small group of lamps, thereby avoiding the necessity of dividing the electric current.

1236. "Electric lamps," &c. J. A. BERLY. Dated March 21. 8d. Relates to the construction of electric lamps, candles, candle holders, switches, or commutators based on new principles and improved methods. Figs. 1 and 2 illustrate the principle of the invention.



When the circuit is open, that is to say, when the current is not passing and the lamp is at rest, the carbon pencils, n, n^1, are apart from and parallel to each other, the armature, d, and its attached movable carbon holder, b, pressing by the effect of their own weight on the stop or rest, e. On the current being sent through the circuit, the current finds no issue through the carbon pencils, n, n^1, but follows the path of the continuous route opened to it through the electro-magnet, m. The magnetism of the magnet, m, attracts the prolonged armature, d, and the oscillating motion thus given to the said armature round its elastic spring hinges, o, causes the movable carbon pencil, n^1, to approach the fixed one, n, until their point or extremities come in contact, at which moment another path is open to the current, and as the resistance of the electro-magnet, m, is calculated to be very much greater than the total resistance of the candle and voltaic arc, the current leaves the magnet to choose the less resistant path, and by so doing the electro-magnet, m, relieves its armature, d, and the weight of the said, together with its attachment, causes the movable carbon pencil, n^1, to recede from the fixed one, n, and a gap being thus produced between the points, the candle is kindled, and the voltaic arc spreads and keeps at the point until the carbon pencils are consumed, or the circuit is open either accidentally or otherwise. In this latter case everything remains in the same position until the reinstatement of the current or relighting of the lamp by the closing of the circuit, when the same things happen in the same order as before, that is to say, the movable carbon pencil approaches the fixed one, their points touch, the movable carbon pencil then recedes from the other, and the light is produced. When the light is burning the armature and its attachment of movable carbon holders is in a perfectly fixed position, as it is resting on e by the effect of its own weight, and there can be therefore no vibrating motion imparted to it by the alternations of the current, as it is the case when the said armature and its attachment have to be maintained in their working position by the attracting force of the electro-magnet. The light is therefore perfectly fixed, and at the same time perfectly silent, as when the lamp is at work there is no part to which a vibrating motion could be imparted.

1240. "Armatures for electric machines." E. G. BREWER. (A communication from abroad by Thomas

Alva Edison.) Dated March 21. 6d. The object of this invention is to furnish a means of removing and replacing one or more coils of the armature of a dynamo machine. For the active or generative portions of the armature, coils of wire or naked bars are used, electrical connection from face to face being made through discs as hereinafter described. If each longitudinal set of wires or each bar be considered as one coil a series of discs equal in number to half the coils is used at each end of the armature. These discs are made of sheet metal, preferably copper, and are separated each from the other by a layer of insulating material, such as mica, paper, asbestos, or wood veneer. Those of each series are fastened together by bolts passing through holes in all the discs of the series, the bolts being insulated therefrom by insulating washers. The bolts take into screw holes in the ends of the armature itself, so that they not only bind the members of a series together but also secure the series to the armature itself. For the non-commutator end of the

Fig. 2.

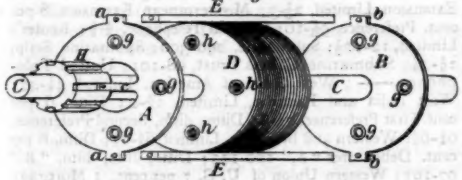


Fig. 1.

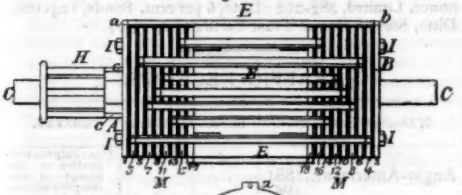
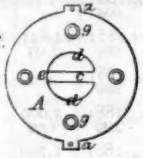
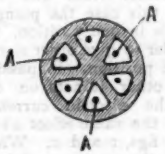


Fig. 3.



armature the discs are made of sheet metal perforated in the centre to admit of the armature shaft passing therethrough, but insulated therefrom. Upon opposite sides of each disc is left a lug or ear by which the disc is attached to its proper bars or wires, so that the circuit at that end is completed between the two diametrically opposite bars or coils. For the commutator end the discs are made of sheet metal, each disc having two ears or lugs upon its periphery for attachment of the wires or bars which it is desired to connect at that end. Near the centre two semi-circular pieces of the metal are cut out, leaving a metal tongue between them, which tongue is cut away from the body of the disc at one end, and then bent outwardly at right angles. The tongue so bent is carried to the commutator block forming the connection of the disc thereto. The lugs or ears upon the discs at this end of the armature are not diametrically opposite to each other, but are so arranged relatively to each other and to the tongue referred to, and the coils or bars are so connected to the series of discs that all or nearly all the coils or bars are constantly in circuit. Fig. 1 shows the series of discs upon the armature shaft. Fig. 2 is a perspective view, showing the elements of the armature. Fig. 3 is an elevation of a disc for the commutator end; C is the armature shaft upon which is mounted the armature core, D, formed of sheet iron discs separated from each other by thin insulating sheets; B is an individual disc of the series, M 1, for the non-commutator end made of sheet metal with lugs or ears, *b*, *b*, thereon; A is an individual disc of the series, M, of the commutator end provided with lugs, *a*, *a*. In each are cut the two semi-circles, *d*, *d*, between which is left the tongue, *c*, which is cut loose from the body of the disc at *e*. This tongue is bent outwardly and fastened to the commutator base, H. The commutator, H, is formed of an insulating cylindrical body of one piece mounted upon the axis of the armature, and with grooves in its face equal in width to the tongue, *c*. The discs, A, are arranged upon the shaft so that each has its tongue, *c*, opposite the proper groove in H; the tongue is then bent outwardly and secured in its proper groove. This is clearly shown in fig. 2, where the tongue, *c*, of one disc, A, is shown as connected to H; the others, as many as are used, are connected in the same way in proper order to H, two being shown in fig. 1, the others being omitted so that the drawings be not obscured. Bolts, I, pass through holes, *g*, in the discs, but are insulated from the body of the discs, the discs being insulated from each other. The inner ends of the bolts are screw-threaded, and take into screw holes, *h*, in the body of the armature, thereby securing the discs together, and the assemblage of discs to the armature. Appropriate discs of each series are connected in pairs by the coils or bars, E, E, bars being preferable, the attachment of discs and bars being made by screws passing through the lugs into the bars. For instance, upon the side shown, discs 1 and 2, 3 and 4, 5 and 6, 7 and 8, 9 and 10, 11 and 12, 13 and 14, 15 and 16, 17 and 18 are connected. Upon the side not shown the connections would be different, the lugs, *a*, *a*, and tongue, *c*, of each disc being so arranged relatively to each other that all or nearly all the coils shall be always in circuit.

1257. "Laying telegraph wires." SYDNEY PITT. (A communication from abroad by W. B. Espeut, of Spring Gardens, Buff Bay, Jamaica, West Indies.) Dated March 22. 6d. An iron tube is lined inside

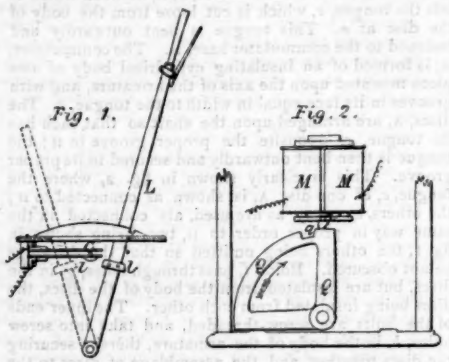


with porcelain, such lining being formed in one or more longitudinal compartments as desired. The figure is an end view of a tube such as is employed according to this invention for containing telegraph wires; *a*, *a*, *a*, are the telegraph wires lodged in the several compartments of the tube.

1453. "Interlocking of railway telegraphic block instruments," &c. CHARLES HODGSON. Dated April 2. 8d. Relates to the improvements in the construction and arrangement of signal apparatus, whereby is effected the interlocking of the instruments at a signalling station with each other, and with those at another

station to provide against negligence in the use of these instruments, and to transmit the necessary electrical currents for working them in both directions along a single line wire.

Fig. 1 represents one of the levers for working a point or signal, and fig. 2 represents part of a block instrument having in it the locking shaft, S. On this shaft is fixed a quadrant arc, Q, having a notch, *q*. Immediately above is fixed an electro-magnet, M, the armature, *m*, of which is held up by attraction, while an electric current passes through the coils of M, the quadrant, Q, and the shaft, S, being in that case free to be moved. On the lever, L, fig. 1, is fixed a piece,



l, which, when the lever is moved over to the dotted position, passing a protuberance from one of a pair of contact springs, C, causes them to make contact, and so to short-circuit the electricity that was passing through the coils of M. By this short-circuiting the magnet, M, loses its attractive power on the armature, *m*, which whenever the notch, *q*, presents itself under it drops into that notch, and so prevents the movement of the quadrant, Q, and shaft, S, in the direction of the arrow. Thus the movement of the lever, L, locks the locking shaft, S, and causes all the levers and instruments connected to S to be retained in the condition in which they were before the lever, L, was moved. Such locking of the shaft, S, and of all connected with it, instead of being effected by the movement of a lever may be effected by the movement of the signalling commutator from one of its positions to the other. In this case the plunger of the commutator when it is in one position, can give certain signals, but in order to give other signals it has to be moved to a second position. In passing from the one position to the other it acts on contact springs, short-circuiting the electric current in the same manner and with the same effect as above described with reference to figs, 1 and 2. When the movable commutator is in the position where it can be employed to signal "line clear" it is arranged that its plunger should be prevented from being more than once pressed in for the purpose of signalling, otherwise the attendant might by negligence permit more than one train to occupy a section of the line at one time.

The following are the final quotations of stocks and shares for Nov. 11th.:—Anglo-American, Limited, 52-52½; Ditto, Preferred, 81-82; Ditto, Deferred, 23-23½; Brazilian Submarine, Limited, 11⅛-11⅜; Brush Light, £4 paid, 7½-8½; Ditto, £10 paid, 17-18; Electric Light, 1⅛-1⅜; Consolidated Telephone Construction, ⅜-1⅛; Cuba, Limited, 9½-9¾; Cuba, Limited, 10 per cent. Preference, 16-17; Direct Spanish Limited 5-5½; Direct Spanish, 10 per cent. Preference, 14½-15½; Direct United States Cable, Limited, 1877, 10¾-11¼; Debentures, 1884, 100-103; Eastern Limited, 10-10½; Eastern 6 per cent. Preference, 12⅞-13⅛; Eastern, 6 per cent. Debentures, repayable October, 1883, 100-103; Eastern 5 per cent. Debentures, repayable August, 1887, 100-103; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 11-11¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 103-106; Ditto, registered, repayable 1900, 103-106; Ditto, 5 per cent. Debenture, 1890, 99-102; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 102-105; Ditto, ditto, to bearer, 102-105; German Union Telegraph and Trust, 10½-11; Globe Telegraph and Trust, Limited, 6½-6¾; Globe, 6 per cent. Preference, 12½-12¾; Great Northern, 12-12⅛; 5 per cent. Debentures, 103-106; India Rubber Company, 23½-24½; Ditto, 6 per cent. Debenture, 104-108; Indo-European, Limited, 27½-28½; London Platino-Brazilian, Limited, 4-5; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9½-10; Oriental Telephone, ⅜-½; Reuter's Limited, 12-12½; Submarine, 290-300; Submarine Scrip, 2⅛-2½; Submarine Cables Trust, 98-101; United Telephone, ——; West Coast of America, Limited, 4¼-4⅝; West India and Panama, Limited, 1½-2; Ditto, 6 per cent. First Preference, 7½-8; Ditto, ditto, Second Preference, 6¼-6½; Western and Brazilian, Limited, 6¼-7¼; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 97-101; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 123-128; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 28¾-29¼; Ditto, 6 per cent. Bonds, 104-108; Ditto, Second Bonus Trust Certificates, 1⅛-1¼.

TRAFFIC RECEIPTS.

NAME OF COMPANY.		SEPT.	OCTOBER	REMARKS.
		£	£	
Anglo-American...	1881	...	..	From July the publication of the receipts of this company are suspended.
	1880	..	..	
Brazilian S'marine	1881	14,841	12,909	
	1880	*13,585*	*14,101*	
Cie. Française ...	1881	...	...	
	1880	..	..	Not published
Cuba Submarine..	1881	2,000	2,300	
	1880	*1,710*	*2,102*	
Direct Spanish ...	1881	1,790	2,063	
	1880	*1,557*	*1,821*	
Direct U. States ...	1881	...	...	From July the publication of the receipts of this company are suspended.
	1880	..	..	
Eastern	1881	47,407	48,872	
	1880	*41,717*	*45,570*	
Eastern Extension	1881	30,866	31,164	
	1880	*28,771*	*29,061*	
Great Northern ...	1881	22,280	21,160	
	1880	*22,320*	*22,480*	
Indo-European ...	1881	...	...	Not published.
	1880	..	..	
Submarine	1881	...	...	Publication temporarily suspended.
	1880	..	..	
W. Coast America	1881	...	...	
	1880	..	..	
West. & Brazilian	1881	9,530	..	Not published.
	1880	*9,575*	..	
West India	1881	3,964	3,848	
	1880	*1,384*	*2,272*	